Shapefile Creation (Digitizing)

— An Overview of Shapefiles
1. A shapefile is a data format created by ESRI to store spatially-referenced geometries.
2. Shapefiles store geometry objects in the form of points, lines and polygons.
    a. Lines and polygons are really just made up of a series of points.
3. A shapefile consists of multiple files; however, you will probably only ever deal with the **.shp** file (this file should also have a special QGIS icon when viewed in the Windows File Explorer).
    a. A shapefile is accompanied by supporting files. The supporting files must be stored in the same folder with the file they support. These files will share the same filename as the **.shp** file, but will have a different extension. You will always see a **.shx** file (feature index) and a **.dbf** file (attribute table), however there may be other files included as well.

— Create a New Shapefile
1. Click on the **New Shapefile Layer** button in the **Manage Layers Toolbar** at left (or go to *Layer > Create Layer > New Shapefile Layer…*) to create a new shapefile.
2. In the pop-up window, select a shapefile type (point, line, polygon — any shapefile can only contain one geometry type)
3. Select a CRS for the shapefile to be saved to.
    a. Use WGS84 if you want to use w/ google earth
    b. Otherwise, generally use the same CRS as the data it will be used with
    c. We will use Vernon County WISCRS
        - Using the appropriate CRS for your region is important if you hope to perform accurate spatial calculations on your data.
4. Specify attribute fields *(you can also do this later, see BONUS section below)*
    a. An attribute field has a…
        - name (must be less than 10 characters)
        - type (text, whole number, decimal number, date)
        - length (how many characters the field can hold, max 255)
        - precision (number of decimal places in a decimal number field, up to 15)
    b. By default, a new shapefile will have an *"id"* field. You should see this listed in the Fields List below.
5. To add an attribute field, first provide a name in the text field, and select what type of data that field will hold. Then specify how many characters the field can hold (length), and the precision (number of decimals, if necessary). Finally, click "**Add to fields list**". You will now see the attribute field listed below.
    a. To remove an attribute field, select it in the Fields List and click "**Remove field**".
6. Press OK, then specify a save location and name. Finally, click "**Save**".
7. Your new shapefile should be added to your "Layers" panel automatically.

— Editing Your New Shapefile Layer
1. To edit a shapefile, you must first turn on editing mode for the shapefile layer. Do this by first selecting the layer you want to edit in the Layers Panel, then click "**Toggle Editing**" (✏) in the toolbar.
    a. While you are in editing mode, you can see a small pencil icon superimposed over the layer's icon in the Layers Panel.

— Add a Feature to Your Shapefile
1. To add a new feature to your shapefile, use the "**Add Feature**" tool. You can find this in the toolbar next to the other editing tools. You will see a different icon depending on whether you are editing a point ( ), line ( ) or polygon ( ) shapefile.
    a. While using the "**Add Feature**" tool, you will notice your cursor changes to a crosshairs when hovering over the map view.
2. Click on the map canvas to begin placing points.
    a. Delete the most recent point you placed by pressing the *Backspace/Delete* key.
    b. Cancel the feature creation by pressing the *Esc* key.
    c. While digitizing, it can be very handy to use the arrow keys to nudge the map canvas in one direction or another. This helps you avoid switching tools.
3. Right-click to finalize the creation of your new feature.
    a. A popup dialogue will give you a chance to enter attribute values for the new feature. You can also do this later through the attribute table.

— Edit a Feature in Your Shapefile
1. To edit the geometry of an existing feature, use the **Node Tool** ( ). This tool can be found in the Digitizing Toolbar with the other editing tools.
2. Using the node tool, click on an edge or node of a feature to highlight it. You should notice that each node in the feature becomes highlighted by a small red square. You can now click and drag to adjust the positioning of these nodes
    a. Click and drag on a node or edge to move it.
    b. Click on a node to select it. A selected node will turn blue.
    c. Hold **ctrl** while selecting to add to or subtract from the existing selection.
    d. Click and drag on the canvas to select nodes by drawing a rectangle.
    e. Delete a node by selecting it and pressing the *Backspace/Delete* key.
    f. Move a set of selected nodes by clicking and dragging on any one of them.
    g. Add a point along an edge by double-clicking somewhere on the edge.
3. Save edits periodically using the "**Save Layer Edits**" button in the toolbar ( ).

— Delete a Feature from Your Shapefile
1. To remove a feature from your shapefile entirely, you must first activate the **Select** tool ( ). Click on a feature to select it; once selected, it will become highlighted in yellow. Press the *Backspace/Delete* key to remove the feature.

— Exit Edit Mode

1. Click "**Toggle Editing**" (✏️) in the toolbar (make sure to set your shapefile layer as the active layer first). If there are unsaved edits, you will be given a chance to save them.

— BONUS: Calculate Area & Perimeter for Polygons

1. Before we can make our calculations, we will need to know what units QGIS will ▦ be using. Check your project properties (*Project > Project Properties…*) and look under the "General" tab to set your preferred measurement units (I use ft / ac).
2. Open the attribute table for your shapefile by clicking on the "**Attribute Table**" ( ) button in the toolbar.
3. Make sure editing is turned on for your shapefile layer.
4. In order to calculate values for area & perimeter and attach those values to the geometry, you will need to have attribute fields ready-made to store these values.
    a. If you have not already created fields for area and perimeter, do so by clicking on "**New field**" in the attribute table toolbar ( ). ▤ Give the field a name (e.g. 'area'), specify the type as *Decimal Number (Real)*, and set the length to 10 and the precision to 2.
    b. If you create a field with the wrong parameters, you can delete that field using the "**Delete field**" tool in the attributes table toolbar ( ). ▤
5. Directly below the toolbar in the attribute table, you will find an interface for updating the attribute fields:

6. In the drop-down menu at left (**1**), select the field you want to update (e.g. *'area'*).
7. In the text field (**2**), enter the appropriate expression:
    a. *$area* : the *$area* operator will return the area of a vector feature. In my case it will return the measurement in acreage; if you have it set to provide area in square footage, you could use the expression *$area/43560* to convert to acres.
    b. *$perimeter* : the *$perimeter* operator will return the perimeter of a feature. If we want perimeter in miles, we could use the expression *$perimeter/5280*.
    c. If you have a shapefile containing line geometries, you may use the operator *$length*.
8. Press "**Update all**" (**3**) to update the feature attributes based on the expression you provided. You should see that the *area* and *perimeter* fields in the attribute table have been filled.